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Multi-Frequency VSOP and VLBA Polarization Observations of 3C 279 and 3C 345

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Abstract. This contribution presents preliminary results from coordinated polarization sensitive VSOP and VLBA imaging of the blazars 3C 279 and 3C 345 at multiple frequencies.

1. Imaging Relativistic Jets with Space-VLBI

One of the primary goals of orbiting-VLBI, and the VSOP mission in particular, is to image compact radio sources at low frequencies with resolution comparable to that of higher frequency ground-based only observations. This facilitates resolution independent spectral and polarization (rotation measure and field orientation) mapping of relativistic jets in AGN, a capability that is compromised when only ground-based interferometers are used.

To this end, we have obtained polarization-sensitive observations of four bright 3C quasars using the VLBA at 8.4, 15, 22, and 43 GHz, plus coordinated VSOP plus ground station observations at 1.6 and 5 GHz. Here, we present some preliminary results from our first-epoch mapping of 3C 279 (in April 1999) and 3C 345 (from July-Sept. 1998). Chen et al. (2003, this volume) present results on 3C 454.3; work on the fourth source, 3C 273, is in progress.

2. The Parsec-scale Jets in 3C 279 and 3C 345

The quasars 3C 279 ($z=0.536$) and 3C 345 ($z=0.593$) are well-studied VLBI sources (e.g. Piner et al. 2003, Klare et al. 2003) and are ideal targets for this study because of their bright pc-scale jets. Figures 1 & 2 show selected images from our first-epoch observations. The 5 GHz VSOP images of 3C 345 previously appeared in Moellenbrock, Roberts, & Wardle (2000).

Although the addition of the spacecraft mitigates the resolution issue in our study, the non-simultaneity (5 days for 3C 279 and \sim 2 months for 3C 345) of the VLBA only and VSOP observations hampers a direct comparison of the images because of flux variability; we plan to resolve this by extrapolating from other

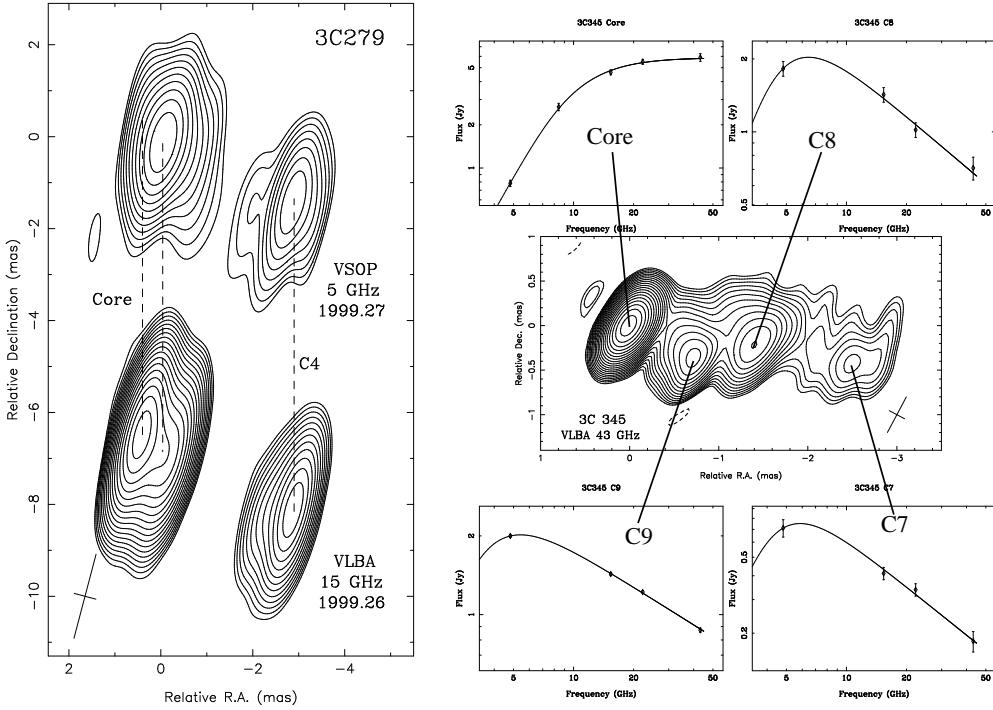


Figure 1. [left] Matched resolution total intensity images of 3C 279 (using restoring beam from the VSOP observation). [right] Spectra of the 3C 345 core and jet features indicated on a VLBA 43 GHz image. The self-absorbed spectra fit to the data are shown.

contemporaneous data. We aligned the images using well-defined optically thin features in the jets as labeled in the figures. The proper motion of C4 in 3C 279 (0.4 mas/yr; Homan et al. 2003) does not compromise the image registration over the 5 day difference between observing epochs, and assuming a typical motion of ~ 0.3 mas/yr (Ros, Zensus, & Lobanov 2000), the shift in 3C 345 is only $\sim 1/8^{\text{th}}$ the beamwidth in the jet direction at 5 GHz (Fig. 2).

Once registered, we see in both objects, that the brightest feature at 5 GHz is further downstream from the core than at the higher frequencies, and is not the core itself (seen in the higher frequency images); thus opacity effects are important within our observing bands. In 3C 345, the modelfits (Fig. 1) and polarization maps (Fig. 2) show that the core is almost completely self-absorbed and depolarized at 5 GHz. This may explain the lack of circular polarization in the core at 8.4 GHz, but its detection at 15 GHz (Homan & Wardle 2003). We find also a low rotation measure in the core and jet, as measured previously by Taylor (1998). The 3C 345 spectra also show hints that the jet is beginning to become opaque near 5 GHz – this should become more apparent in the 1.6 GHz VSOP data. Lastly, there is a noticeable shift in the position of its core measured at 5 GHz, with respect to the higher frequency 15 to 43 GHz observations, which

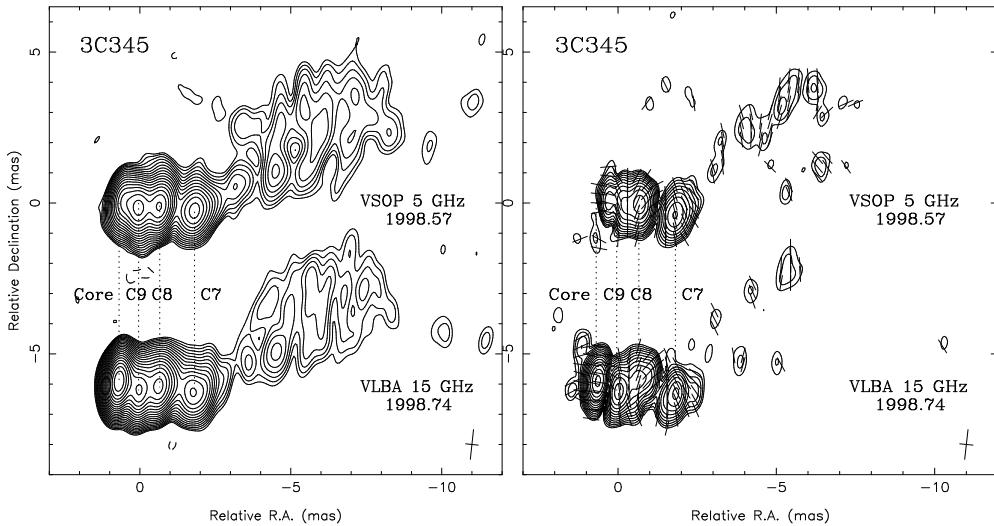


Figure 2. Matched resolution (as in 3C 279; Fig. 1) total intensity [left panel] and polarized intensity with ticks indicating electric field direction [right] images of 3C 345.

can not be reconciled by component motions over the ~ 2 month elapse between the observations – it would require that all three jet components move more than 3 times faster than typically observed (Ros et al. 2000). Analysis of the L-band VSOP data for both objects are in progress, and observations at other epochs will track variability.

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